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Myxomycete diversity of the Altay Mountains (southwestern Siberia, Russia)

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Abstract — A survey of 1488 records of myxomycetes found within a mountain taiga-dry steppe vegetation gradient has identified 161 species and 41 genera from the southeastern Altay mountains and adjacent territories of the high Ob' river basin. Of these, 130 species were seen or collected in the field and 59 species were recorded from moist chamber cultures. Data analysis based on the species accumulation curve estimates that 75–83% of the total species richness has been recorded, among which 118 species are classified as rare (frequency < 0.5%) and 7 species as abundant (> 3% of all records). Among the 120 first species records for the Altay Mts. are 6 new records for Russia. The southeastern Altay taiga community assemblages appear highly similar to other taiga regions in Siberia but differ considerably from those documented from arid regions. The complete and comprehensive illustrated report is available at http://www.Mycotaxon.com/resources/weblists.html.

Key words — biodiversity, ecology, slime moulds

Introduction

The myxomycete diversity of coniferous boreal forests of Siberia is poorly studied. So far, only a few local species inventories are available (Novozhilov et al. 1999, Kosheleva et al. 2008). Prior to this study, only 41 species had been recorded from the Altay Mts. in Russia (Barsukova 2000, Lavrov 1929, Novozhilov 1987). During four weeks in August 2008, the central and southeastern Altay Mts. and lowland forests near Barnaul city were studied by the first three authors conducted extensive fieldwork as well as substrate collecting for moist chamber cultures. Objectives of this study were: (1) to obtain baseline data on myxomycete abundance and biodiversity in the Russian Altay, (2) to determine to what extent myxomycete assemblages follow the vegetation and precipitation

gradients in the region, and (3) to use abundance data to estimate the degree of completeness that can be achieved in a quantitative survey.

Materials and methods

Our study regions are situated in north, central, and southeastern Altay: near Barnaul city; around Lake Teletzkoe (the Altay State Nature reserve); and numerous localities along state road M32 (Chuyskiy Trakt), which essentially follows the northwest–southeast rainfall gradient over several ridges of the Altay Mts. towards the Russian-Mongolian border.

Localities were assigned to one of six vegetation types (Kamelin et al. 2005): steppe (8 localities), mountain forest–steppe (14 localities), light coniferous taiga (10 localities), stripe pine forest (11 localities), dark coniferous taiga (30 localities), and "chernevaya" taiga (27 localities).

A total of 510 substrate samples were collected for moist chamber cultures. These included bark from living trees and shrubs, plant leaf litter, litter of grasses and herbaceous plants, decaying conifer cones on the ground, litter of small twigs, woody debris, and the dung of herbivorous animals such as camel, cow, horse, sheep, and various rodents. Moist chamber cultures were prepared according to Härkönen (1977). A species accumulation curve was used (Colwell 2006) to estimate the extent to which our survey was exhaustive. Species diversity was calculated using Shannon's diversity index H′. The myxomycete assemblages were compared by using the adjusted incidence-based Sørensen index developed by Chao et al. (2006) and computed with EstimateS. Voucher specimens have been deposited in their respective institutes by Novozhilov [Fungal Herbarium, Komarov Botanical Institute, Laboratory of Systematics and Geography of Fungi (LE)], Schnittler [Botanische Staatssammlung München (M)], and Fefelov [Institute of Plant and Animal Ecology of the Russian Academy of Sciences].

The annotated checklist of the region was compiled from the results of our quantitative survey, the collections of the fourth author and published studies. Since the three publications available for the region give rough annotations of abundance as well, we could assign an abundance estimate according to Stephenson et al. (1993) to all taxa.

Results and discussion

Species diversity — This study was based on a total of 1488 records representing 161 taxa from 41 genera and 11 families. However, 118 taxa were classified as rare for whole study area (< 0.5% of all records). We report 120 taxa for the first time for the Altay Mts. of which 6 are new records for Russia. The quantitative part of the survey considers 1174 records representing 152 species. Of these, a total of 315 records were derived from 510 moist chamber cultures, which served to complement the field component. Approximately 40% of the species determined to be common (19 of 45) were observed in the field as well as in moist chamber cultures. In contrast, most lignicolous species and those found to inhabit the forest floor litter were only found in the field (102 species, 805 records in total). Almost all records of (59 of 81) from dry steppe and forest-steppes originate from moist chamber cultures.

Map of the Altay Mountain region. Sampled localities are indicated by black rectangles. Lakes, rivers and lowland forests are marked dark gray. A dotted black line indicates the borders between countries, and between Russian administrative political territories.

Inset: geographical position of the study area. Sources: Microsoft Encarta Reference Library, 2002 and Google Earth (modified).

Distribution patterns of myxomycetes within vegetation types of the Altay Mts. — Collectively the species observed in the field and those recovered from moist chamber cultures, displayed a pronounced trend of increasing alpha-diversity and species richness moving from dry steppe to dark coniferous taiga and secondary mixed aspen and birch forests and to "chernevaya" taiga and mixed forests and then decreased again moving to stripe pine and mixed forests in submontane landscape in the forest-steppe zone. In addition, the species/genus (S/G) ratio was rather low in the dry steppe vegetation. Myxomycete assemblages from arid regions of the Altay Mts. showed high similarities with those of other Central Asian regions. The myxomycete assemblages of the light coniferous taiga and stripe pine forest can be regarded as depauperate versions of the dark coniferous forests.

Substrate-species relationships — Both species richness and diversity varied considerably within groups of substrates, with wood housing the most diverse myxomycete community. However, in spite of a high number of samples processed, wood performed poor in moist chambers when compared to field collections. An unexpected result of this study was the discovery quite rich myxomycete assemblage on decaying conifer cones. This substrate is slightly acidic, and all species were recorded from moist chambers. Most common was *Echinostelium minutum* and *E. corynophorum*.

Conclusions

There seem to be numerous explanations for the relatively high diversity of myxomycetes in the Altay Mountains (a region with ca. 2700 vascular plants, Kamelin 2005), where 161 species of myxomycetes are now known, compared with other regions. First, the rainfall gradient and the diverse vegetation types

associated with it allow desert myxomycetes (e.g. *Physarum* cf. *notabile*) as well as species adapted to moss-covered wood (e.g. *Barbeyella minutissima* and *Colloderma oculatum*) to exist. Second, the continental climate results in fairly high summer temperatures, allowing some species with mainly tropical distributions (*Cribraria languescens, Physarum globuliferum,* and *Tubulifera microsperma*) to persist. In general, pronounced fluctuations (both in temperature and rainfall) seem to favor myxomycetes with their various dormant stages over the true fungi, supporting the hypothesis of a reverse pattern of global diversity in myxomycetes, with deserts and temperate forests being more diverse than moist tropical forests. Detailed analysis of myxomycete diversity and ecology in the study area are presented on the web paper.

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